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SECOND REVISION

CHANGE 1

15 MAY 1965

PAGE 1 OF 1 PAGE(S)

# ROCKET MOTOR MK 6 MODS 0, 1, 2, AND 3 (1.8KS-7800X113C SERIES); DESCRIPTION, OPERATION, MAINTENANCE, AND HANDLING INSTRUCTIONS (U)

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6. Page 17, add "or Mk 258 Mod 0" after "Mk 172 Mod 0" in the second line of the first column and the fourth line of the second column.
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**MODIFIED HANDLING AUTHORIZED** **SECOND REVISION**

# ROCKET MOTOR MK 6 MODS 0, 1, 2, AND 3
# (1.8KS-7800X113C SERIES)

## DESCRIPTION, OPERATION, MAINTENANCE, AND HANDLING INSTRUCTIONS (U)

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DATED 28 FEBRUARY 1958

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Before proceeding with the installation of the Firing Circuit be very sure that the Switch Indicator Handle is in the SAFE position, and the Safety Clip Assembly is in place. (page 30G)

Retain 3-Pin Shorting Plug and Shorting Cap. These are to be used should the removal of a loaded igniter from a rocket motor become necessary. (page 30G)

Just prior to aircraft takeoff, manually arm igniter by removing the Safety Clip Assembly and turning the Switch Indicator Handle to ARM position. Retain Safety Clip Assembly to facilitate disarming igniter immediately after aircraft landing. (page 30G)

Any ohmmeter which passes more than 5 milliamps through the resistance being measured or is not accurate within ± 2% shall not be used. It may pass sufficient current to actuate the igniter. (page 28A)

Do not install Mk 172 Mod 0 igniter in rocket motors to be used with F4H-1 aircraft. This igniter will malfunction in the ejection launcher installation. (pages 8A and 26A)

If this nut must be removed after installation, it is imperative that it be replaced with a new nut to insure secure installation of the Switch Body. (page 30A)

A check shall be made to ascertain that the Handle is tightly in place. (page 30C)

Do not apply torque to housing assembly, Figure 6A. The housing is made of aluminum and is free to rotate on igniter cap assembly. (page 30D)

It is mandatory that the switch installation and checkout be completed prior to igniter installation. (page 30C)

## Chapter 2

# DESCRIPTION

### General Description

Rocket Motor Mk 6 Mod 3 is a self-contained solid-rocket propulsion system. Internally, the motor consists of two concentric solid-propellant charges fitted within a thin-walled, ceramic-lined steel chamber, figure 2, terminating in a flared nozzle exit cone. The propellant charges comprise two tubular grains which are supported by spacers and trap assemblies. An electrically operated igniter, installed in the forward closure, is used to initiate propellant burning. Expanding propellant hot gases provide thrust necessary to propel the missile rapidly forward.

### Leading Particulars

Leading particulars of Rocket Motor Mk 6 Mod 3 are listed in table 1. Weights and dimensions for the motor are listed in table 2, and principal dimensions are shown in figure 3.

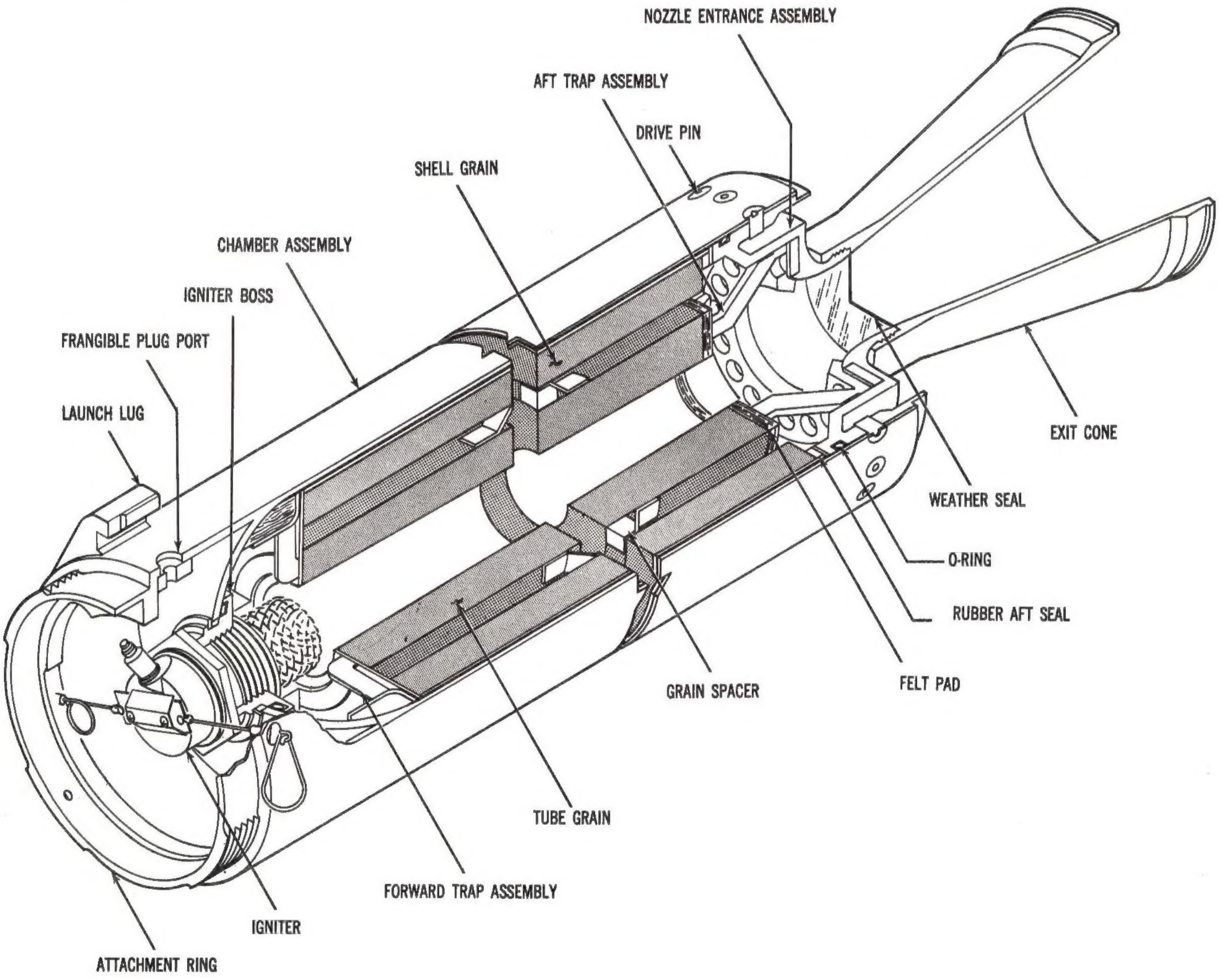

*Figure 2—Rocket Motor Mk 6 Mod 3, Internal Construction.*

TABLE 1 - LEADING PARTICULARS FOR ROCKET MOTOR MK 6 MOD 3

| Item | Value |
|---|---|
| ELECTRICAL REQUIREMENTS FOR IGNITER MK 172 MOD 0 | |
| Recommended firing voltage | Standard Aircraft Power Supply |
| Recommended minimum firing current to glow plugs | 17 to 23 amperes |
| Maximum igniter-tester current to glow plugs for continuity test | 0.04 ampere |
| Maximum safe no-fire current to glow plugs | 2.5 amperes |
| Igniter resistance - two glow plugs in parallel | 0.25 ± 0.05 ohm |
| ELECTRICAL REQUIREMENTS FOR IGNITER MK 258 MOD 0 | |
| Recommended firing voltage | Standard Aircraft Power Supply |
| Recommended minimum firing current to initiator | 15 to 26 amperes |
| Maximum igniter-tester current to initiator for continuity test | 0.005 ampere |
| Maximum safe no-fire current to initiator | Less than 1.0 ampere |
| Igniter resistance - two bridgewires in parallel | 0.50 ± 0.50 ohm |
| TEMPERATURES | |
| Maximum safe storage temperature for motor and igniter | 150°F |
| Recommended storage temperature range for motor and igniter | -75 to 150°F |
| Firing temperature range of motor | -10 to 140°F |
| Auto-ignition temperature of propellant | 580°F |
| Auto-ignition temperature of igniter | 572°F for Mk 172 Mod 0. To be determined for Mk 258 Mod 0 |
| Flame temperature of burning propellant | 3750°F |
| FLIGHT LIMITATIONS | |
| Recommended maximum firing altitude | 30,000 feet for Mk 172 Mod 0 and existing nozzle weather seal<br>75,000 feet for Mk 258 Mod 0 |
| Flight time | None |

TABLE 1 - LEADING PARTICULARS FOR ROCKET MOTOR MK 6 MOD 3 (Cont.)

| Item | Value |
|---|---|
| PERFORMANCE | |
| Thrust, normal operation | 7800 lbs |
| Duration | 1.8 sec |
| Specific impulse | 210.5 lb-sec/lb |
| Nominal total impulse | 14,588 lb-sec |
| STORAGE | |
| Storage time limit | Indefinite |

## COMPONENT DESCRIPTION

CHAMBER ASSEMBLY. The chamber assembly, figure 2, is a deep-drawn, steel alloy cylinder with a wall thickness of 0.057 inch. The chamber is ceramic lined to prevent excessive chamber heating during firing. A missile attachment ring is welded to the forward end of the cylinder. An interrupted thread, for use in attaching motor to body of missile, is machined on the attachment ring. The aft end of the cylinder is drilled radially in 30 places for attachment of the nozzle entrance assembly. Three pairs of waveguide clips, figure 3, are spot-welded to the underside of the chamber and are an integral part of the chamber. These clips serve as a means of attachment for the phase "C" missile waveguide antenna.

The forward closure contains a threaded boss for installation of the igniter. A pressure tap also is located on the forward closure at a position 135 degrees counterclockwise from top center of chamber when viewed from the front. This pressure tap may be used for attachment of a pressure transducer or other accessory equipment. Two holes, fitted with steel knockout plugs, are located in the motor forward attachment ring for installation of a frangible plug motor fire-connector system. This system is required for ejection launching for the Sparrow III missile from the Aero 7A launcher and is shown in figure 4.

PROPELLANT GRAINS. The solid propellant charge consists of a cylindrical tube grain, figures 2 and 5, within a cylindrical shell grain. The two grains are separated by eight spacers. Both ends of the

TABLE 2 - WEIGHTS AND DIMENSIONS FOR ROCKET MOTOR MK 6 MOD 3

| Item | Value |
|---|---|
| WEIGHT | |
| Before firing | 121.1 ± 1.5 lbs |
| After firing | 51.9 lbs |
| DIMENSIONS | |
| Length, overall | 51.82 in. |
| Diameter of motor | 8 in. |
| Diameter of exit cone | 6.38 in. |

tube and shell grains and the exterior surface of the shell grain are restricted to prevent burning. The auto-ignition temperature of the propellant is 580°F and its flame temperature during burning is 3750°F. The primary gaseous products of combustion are water, hydrogen, carbon dioxide, carbon monoxide, nitrogen, and hydrochloric acid.

The shell grain is supported at the aft end by the nozzle entrance section. The tube grain rests on the aft trap assembly. The forward end of both grains rests against the forward trap assembly. The grains are compressed at time of assembly. Felt pads in forward and aft trap assemblies compensate for the different expansion rates of the propellant and the steel chamber. The felt pad at the aft end of the tube grain, and the rubber seal at the aft end of the shell grain also compensate for minor differences in length between the two grains. A rubber aft seal also prevents escape of propellant gases between shell grain and chamber wall.

NOZZLE ENTRANCE ASSEMBLY The nozzle entrance assembly, Figures 2 and 4, is a heat-treated steel alloy entrance section secured to the after end of the chamber assembly with 30 drive pins. The nozzle entrance assembly incorporates the aft trap assembly and an O-ring seal. The nozzle entrance assembly provides the throat for exit of expanding gases during firing. The exit cone is threaded onto the nozzle entrance assembly. A weather seal, designed to rupture when the motor is fired, is cemented inside the nozzle entrance assembly.

NOZZLE EXIT CONE. The nozzle exit cone is shipped detached from the motor and must be installed on the motor prior to use.

IGNITER MK 172 MOD 0. The igniter assembly. Figures 6 and 7, consists of a cap assembly, a wire mesh basket assembly, a safety switch, and a glow plug. The cap assembly is the main assembly for attachment of igniter components. A mylar disc supports two grams of black powder in the cap assembly recess. The wire mesh basket contains 73.5 grams of pellets. The glow plug, when electrically heated by a 17- to 23-ampere current AC or DC, ignites the initiator charge of black powder which in turn ignites the main pellet charge in the wire basket. The glow plug has a double filament wired in parallel. In the event of a failure of one filament, the igniter will still function properly. The safety switch permits safe handling of the igniter during shipment, storage, testing, and missile assembly operations. The switch also is used to arm the igniter immediately prior to launch aircraft takeoff. The safety switch incorporates a slide plate which is

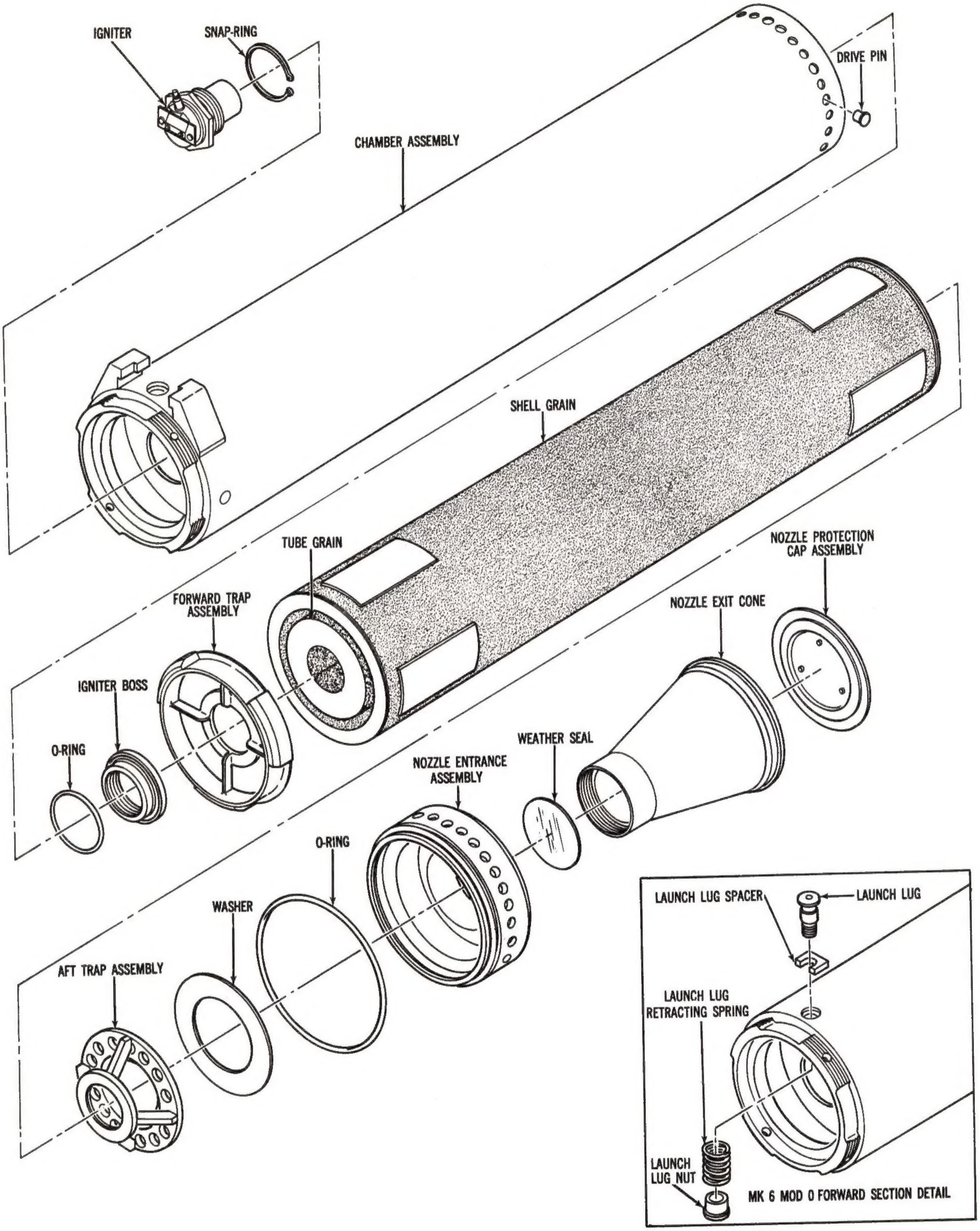

*Figure 5—Rocket Motor Mk 6 Mod 3, Exploded View.*

pulled to the SAFE position for all storage and handling operations, and to the ARM position prior to firing. The igniter has an auto-ignition temperature of 572°F.

WARNING

Do not install Mk 172 Mod 0 Igniters in rocket motors to be used with F4H-1 aircraft. This igniter will malfunction in the ejection launcher installation.

NOTE: Inert igniter assemblies are identified by the word INERT metal-stamped on the igniter adapter, and by the yellow-colored basket assembly and pellets.

IGNITER MK 258 MOD 0. The igniter assembly, Figures 6A and 7A, consists of an initiator within a steel cap assembly, a housing assembly, a wire mesh basket assembly and a safety switch assembly. The cap assembly is the main assembly for attachment of igniter components. A vent plate and an aluminum disk support one gram of ignition powder and one gram of pellets in the cap assembly recess. The wire mesh basket contains 72.5 grams of pellets. The initiator, when electrically heated by a 15- to 26-ampere AC or DC current, ignites the initiator main charge which in turn ignites the ignition powder which in turn ignites the main pellet charge in the wire basket. The initiator has two bridgewires wired in parallel. In the event of a failure of one bridgewire, the igniter will still function properly.

NOTE: This igniter will fire with less than the available 15 amperes.

The safety switch permits safe handling of the igniter during shipment, storage, testing, and missile assembly operations. The switch also is used to arm the igniter immediately prior to launch aircraft takeoff. The safety switch utilizes a Switch Indicator Handle which is turned to the SAFE position for all storage and handling operations and to the ARM position prior to aircraft takeoff. The auto-ignition temperature of the igniter is yet to be determined.

NOTE: Although the Mk 258 Mod 0 Igniter was designed for use with the F4H-1 aircraft, it will perform satisfactorily in any aircraft installation.

SHIPPING PROTECTORS AND SEALING DEVICES. A weather seal cap, Figure 8, and an igniter boss shipping plug are provided with each rocket motor to seal the motor during shipment and storage. A thread protector is furnished to prevent damage to the attachment threads at the forward end of the chamber assembly. A weather seal, cemented to the after face of the entrance nozzle, is used to keep moisture and foreign material from entering the motor interior. The weather seal cap is threaded onto the entrance nozzle to protect the weather seal during shipping and storage. It must be removed prior to installation of the nozzle exit cone. A protective cap is held in place by friction fit inside the aft end of the nozzle exit cone. This cap provides some protection from accidental ignition in the event of ignition of a nearby motor during standby storage. It also

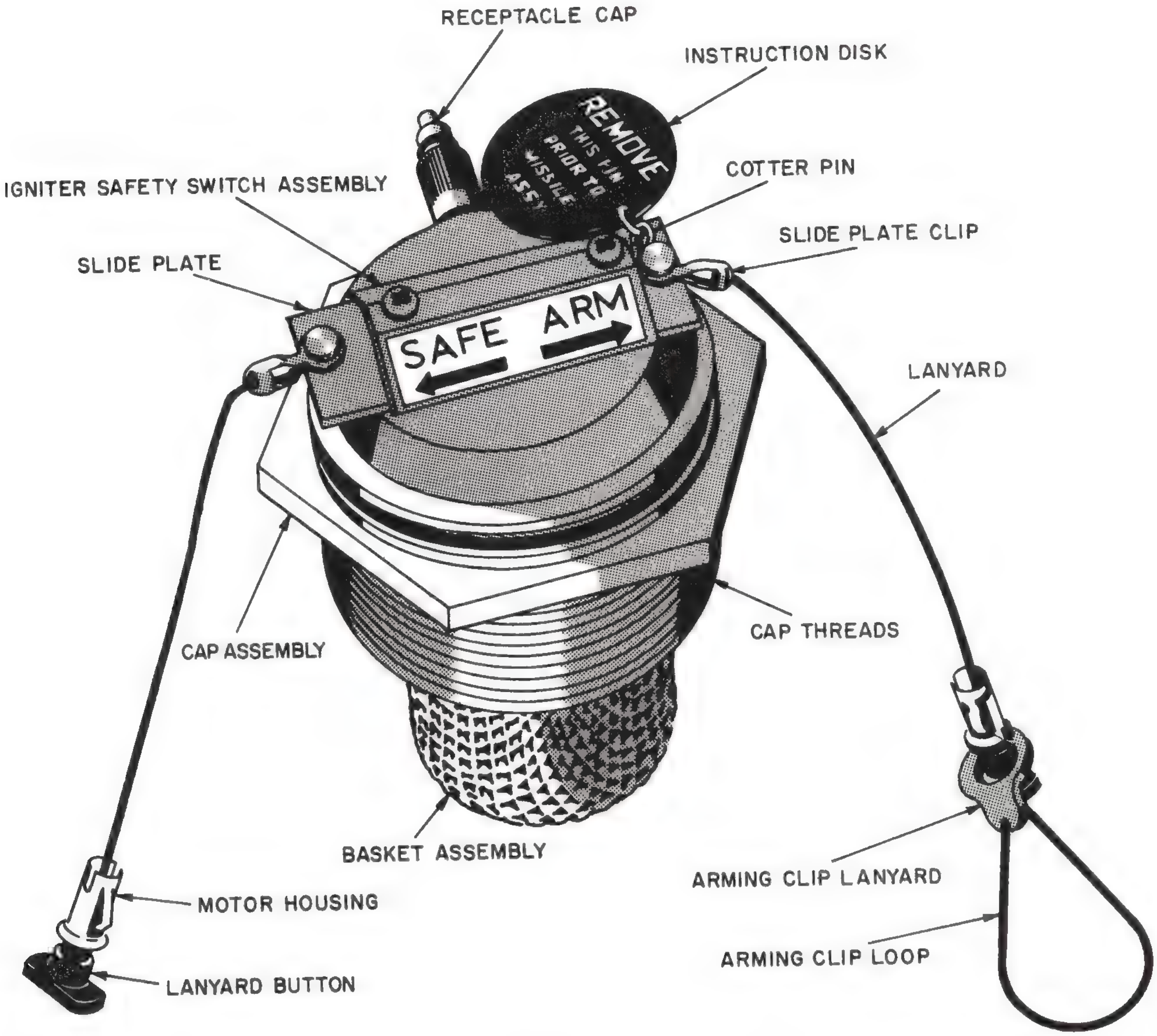

*Figure 6—Igniter Mk 172 Mod 0, External View.*

protects the motor interior against salt spray and foreign material and must be removed prior to firing the motor. All Rocket Motors Mk 6 Mod 3 have three pairs of waveguide clips spot-welded to the underside of each chamber, figure 3. These clips are for attachment of a missile waveguide antenna. Plastic inserts are installed in the clips to prevent damage during shipment, handling, and storage.

All protectors and sealing devices, with the exception of waveguide clip plastic inserts and the entrance nozzle weather seal, may be removed to accomplish routine inspection but must be replaced in motors which are to be placed in long-term storage.

CAUTION: Make certain that nozzle exit cone protective cap is removed prior to firing motor.

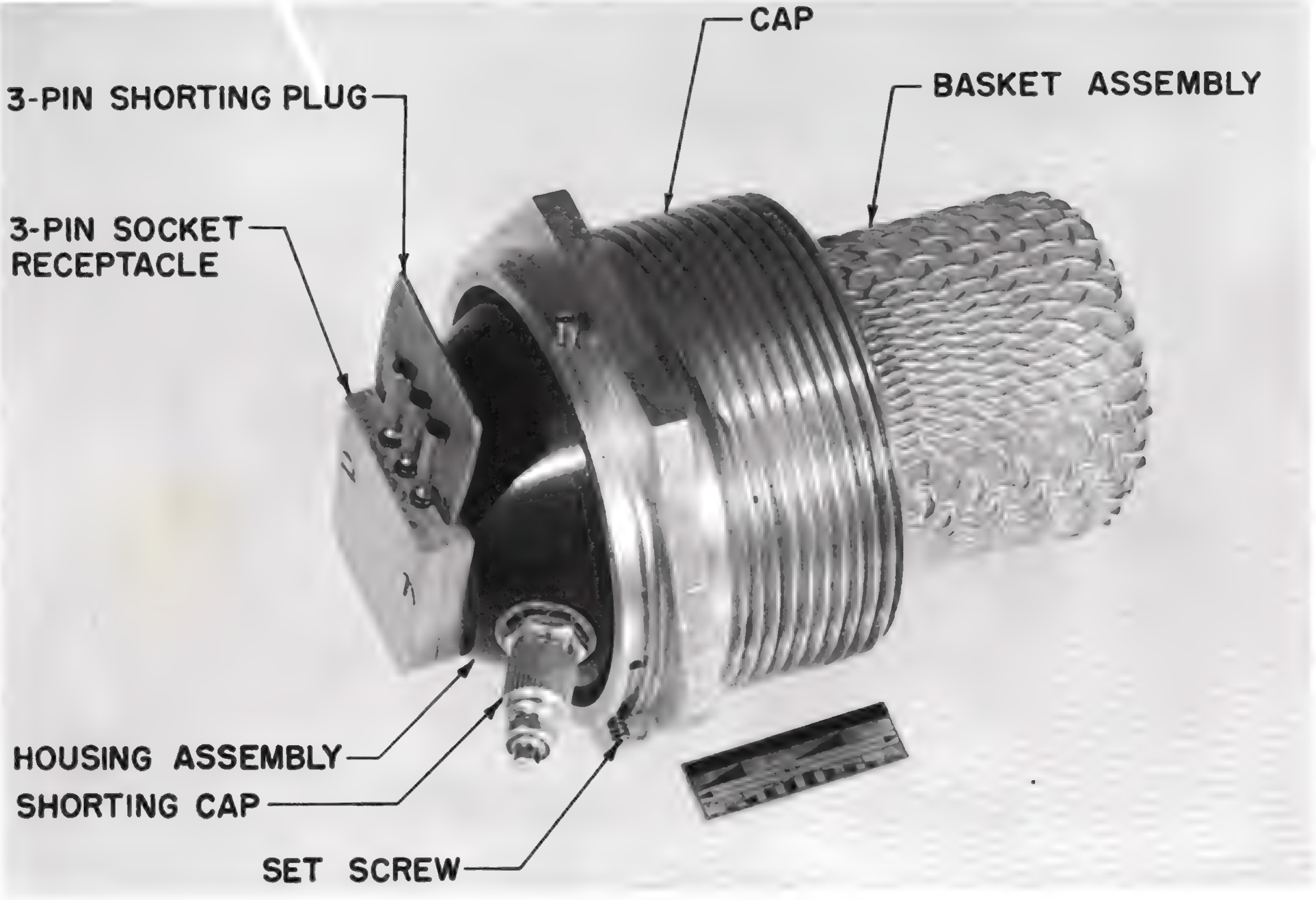

Figure 6A—Igniter Mk 258 Mod 0, External View.

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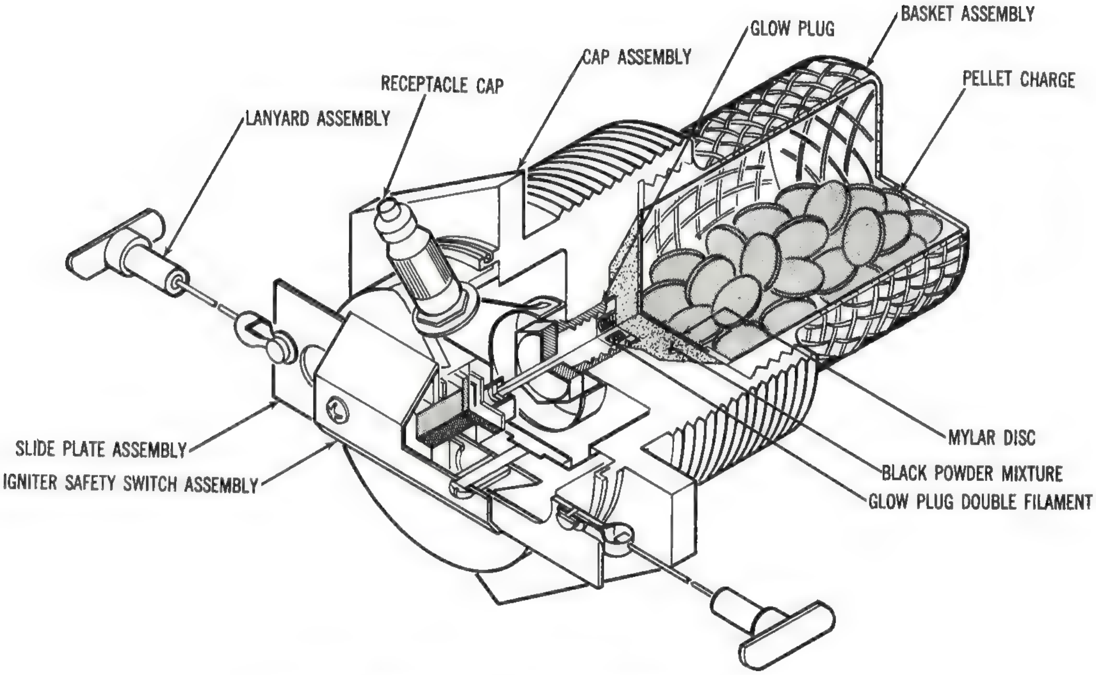


*Figure 7—Igniter Mk 172 Mod 0, Internal Construction.*

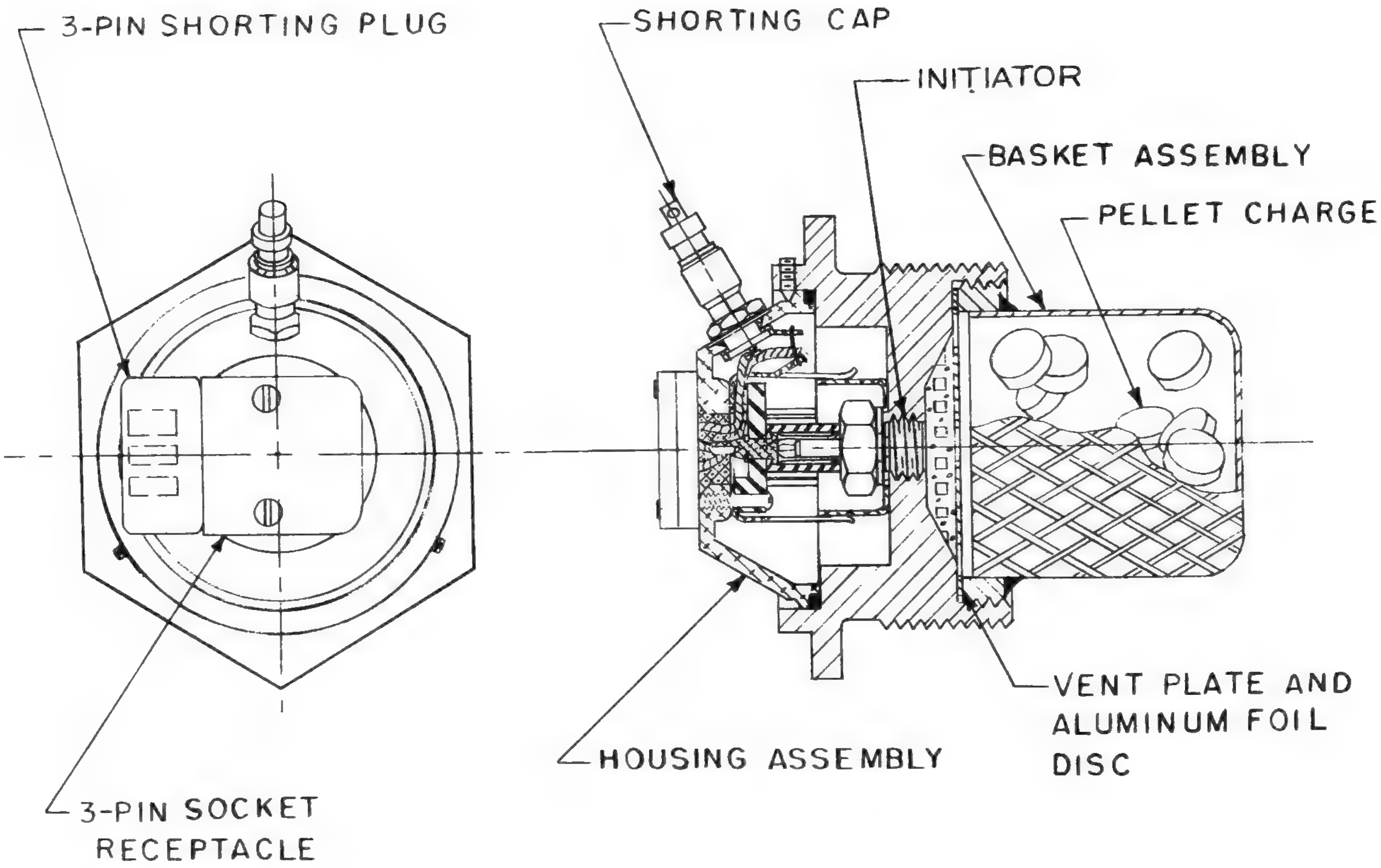


Figure 7A-Igniter Mk 258 Mod 0, Internal Construction.

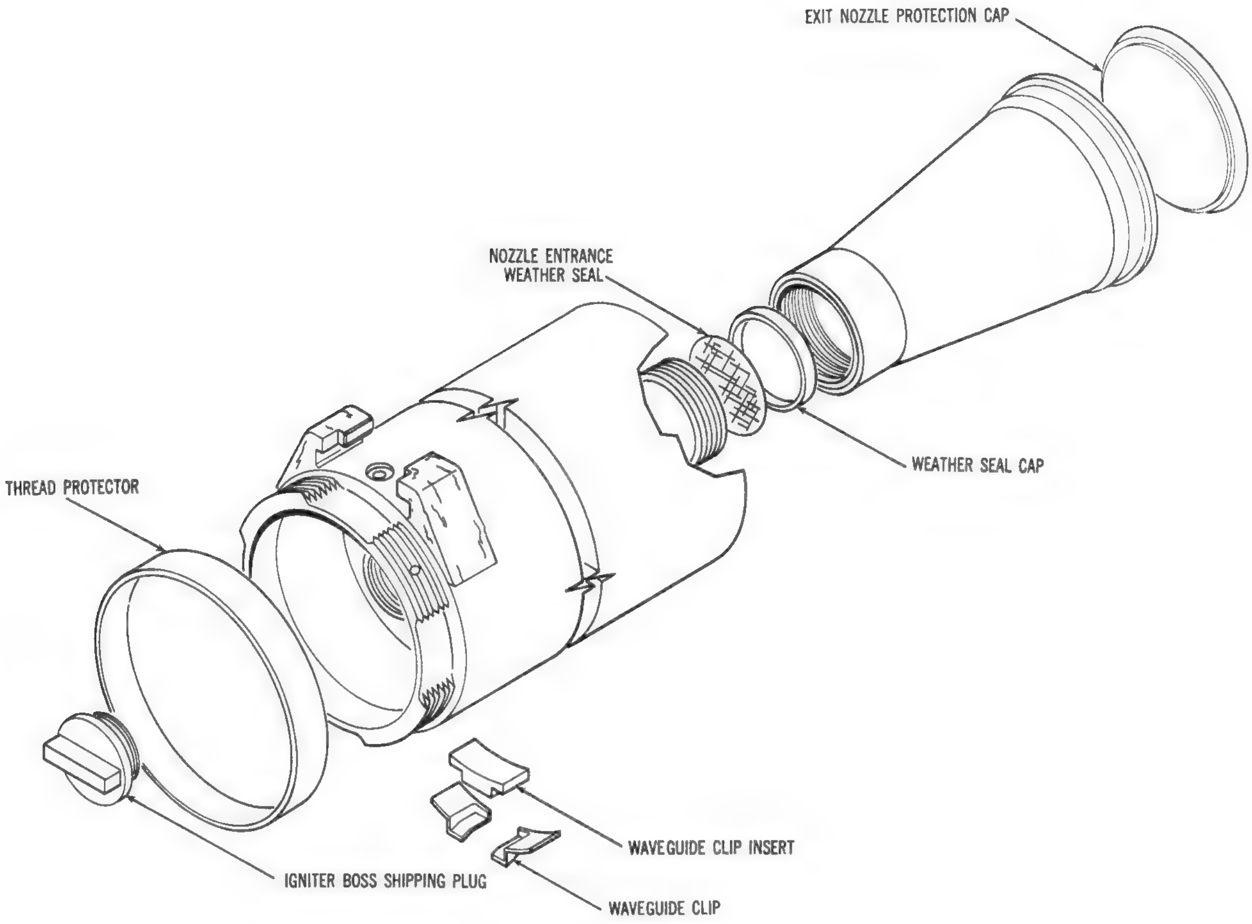

EXIT NOZZLE PROTECTION CAP
NOZZLE ENTRANCE WEATHER SEAL
WEATHER SEAL CAP
THREAD PROTECTOR
WAVEGUIDE CLIP INSERT
IGNITER BOSS SHIPPING PLUG
WAVEGUIDE CLIP

*Figure 8—Shipping Protectors and Sealing Devices.*

# CHAPTER 3

# THEORY AND FUNCTIONAL DESCRIPTION

## PRINCIPLE OF ROCKET MOTOR

BASIC PRINCIPLE. The basic principle of rocket operation is expressed by Newton's Third Law of Motion. For every action there is an equal and opposite reaction. In rocket propulsion, Newton's law is manifested by the action of gases confined in a chamber under pressure and allowed to escape at high velocity through a nozzle. The action of escaping gases exerts an equal and opposite reactive force on the chamber.

Rocket motor gases are obtained by combustion of the rocket motor propellant, a blend of an oxidizer and a fuel. The presence of the oxidizer, which serves as a source of available oxygen, allows the motor to operate independent of the atmosphere.

## FUNCTIONAL DESCRIPTION

ROCKET MOTOR OPERATION. A 17- to 23-ampere current from an AC or DC power supply applied to the igniter, Figure 9, heats the glow plug, Figure 7, which in turn ignites the black powder mixture in the initiator charge of the Mk 172 Mod 0 Igniter. Operation of the Mk 258 Mod 0 Igniter is the same except that the firing current is between 15 and 26 amperes from an AC or DC power supply. The Mk 258 Mod 0 Igniter is a replacement for the Mk 172 Mod 0 Igniter brought about by a need for an increase in reliability and altitude capability, and primarily for use in the Aero 7A ejector launch system of the F4H-1 aircraft. The maximum ignition interval from fire switch to 90% of thrust at -10 to +140°F, is 0.120 ± 0.060 second for the Mk 172 Mod 0 Igniter and 0.105 ± 0.045 second for the Mk 258 Mod 0 Igniter. The ignition interval varies with temperature as shown in Figure 10 (Mk 172 Mod 0 Igniter). Expanding hot gases from the initiator charge ignite the main pellet charge, Figures 7 and 7A, contained in the basket assembly. Burning of the main pellet charge generates sufficient heat to initiate burning of the solid-propellant grains. When chamber pressure has risen to approximately 2 psi as a result of propellant burning, the weather seal in the nozzle assembly ruptures, and the propellant hot gases are exhausted through the nozzle at high velocity. The burning propellant sustains the chamber pressure at operating level while the gases are being expelled through the nozzle. Under normal operating conditions, chamber pressure and thrust remain substantially constant until the propellant is consumed, after which both pressure and thrust drop rapidly to zero. Typical performance curves for Rocket Motor Mk 6 Mod 3, showing thrust and chamber pressure versus propellant burning time, are illustrated in Figures 11 and 12. Estimated total temperature contours in the exhaust stream are shown in Figure 13. These performance curves and contours are for rocket motors assembled with the Mk 172 Mod 0 Igniter. Motors assembled with the Mk 258 Mod 0 Igniter perform similarly except for a shorter ignition delay.

for evidence of damage or mishandling. If this cursory inspection reveals evidence of damage, reject the motor in accordance with NAVORDINST 8025.1, Change 1, dated 12 February 1954, or other applicable directives.

### Firefighting Procedures

In the event of a fire in which a rocket motor is involved, proceed as follows:

**WARNING**

Clear the area of all persons not actually engaged in fighting the fire.

**Rocket Motor in Long-Term Storage.** The motor is essentially nonpropulsive in this condition. However, a forward thrust of approximately 350 pounds is possible because of slight variations in nozzle and igniter boss openings. In the event of a fire in the storage area, proceed as follows:

1. If possible, remove all motors and equipment from immediate area.
2. Control burning material adjacent to burning motor with water or foam.

NOTE: A motor in long-term storage will burn approximately 3 seconds. From a practical point of view, the fire will have burned itself out before it could be extinguished.

**Rocket Motor in Standby Storage.** If a motor is in standby storage or is installed in a missile, with igniter and nozzle exit cone attached, it is essentially propulsive. If a fire occurs in the vicinity of a motor in standby storage, concentrate firefighting efforts on cooling the motor to prevent its ignition, and on containing the fire.

**WARNING**

Under the foregoing condition, the motor will operate, if ignited, at a chamber pressure which may be in excess of the strength of the chamber assembly, weakened by external fire, and will probably explode.

**WARNING**

Extinguishing a burning motor in standby storage, with igniter and nozzle exit cone attached, is not possible. If it appears that a fire may reach a motor, clear the area in front of motor (the direction in which motor would move if ignited and unrestrained) of all persons and equipment.

**WARNING**

If the motor ignites, moves, and strikes a barrier in its path, it will probably explode.

# CHAPTER 6

# INSTALLATION AND CHECKOUT

## SPECIAL TOOLS

No special tools are required during inspection, assembly, or missile buildup. Use an ordinary 2-1/2-inch offset or socket hex wrench to install the igniters. Use a strap wrench or a 6-1/2-inch spanner wrench to install the nozzle exit cone.

## PRE-INSTALLATION INSPECTION

ROCKET MOTOR ASSEMBLY. Perform a pre-installation inspection of the rocket motor assembly as follows:

1. Visually inspect chamber exterior, Figure 2, for nicks, dents, or other evidence of damage or rough handling. Make certain forward attachment ring thread protector is in place. Make certain igniter boss shipping plug is fastened securely in place. If shipping plug is loose, remove it and inspect interior of chamber for cracks in propellant grain or evidence of moisture. Inspect igniter boss threads for nicks, burrs, or evidence of foreign material. Reject motor if propellant grain damage, igniter boss damage, or evidence of moisture are apparent. Clean boss threads using a clean lint-free cloth and light oil, Military Specification MIL-C-15348A (1) or equivalent. Remove burrs using a non-sparking wire brush. Replace shipping plug.

2. Inspect weather seal cap at after end of chamber for tight fit. If cap is loose, remove weather seal and inspect chamber interior for damage to propellant grain or evidence of moisture. If foreign material, broken pieces of propellant or moisture are apparent, reject the motor. Replace weather seal and cap.

WARNING

> If artificial light is required for inspection, use a safety flashlight only. Do not bring power lights or power cords near the motor. Do not insert hands or tools into propellant bore.

3. Inspect waveguide clips, Figure 8, for presence of waveguide clip inserts. Make certain waveguide clips are not broken or bent. Bent waveguide clips may be straightened if great care is used. If clips are broken, reject motor for use with phase C antenna. However, the motor can be used with the Phase A antenna provided the motor passes all other inspections.

4. Visually inspect forward launch hooks for evidence of damage or mishandling. If such evidence is apparent, reject the motor.

IGNITER. Perform a pre-installation inspection of the igniter as follows:

> NOTE: Do not perform this pre-installation inspection of the igniter until just prior to the actual installation of the igniter in the motor.

1. Remove igniter from its shipping container, Figure 18 or 18A. Inspect indicator card for percentage of relative humidity within container. Indicator card color should be a deep blue. Any indication of pink or red on card indicates a relative humidity above 40 percent within container and is cause for rejecting the igniter.

2. Visually inspect igniter for nicks or dents resulting from dropping or mishandling. Inspect igniter basket assembly, Figure 6 or 6A, for perforations or evidence of powder or pellet loss. Check basket for looseness in igniter cap assembly. (For the Mk 172 Mod 0 Igniter, check for presence of instruction disk and lanyard assembly. These last two items should be secured to a cotter pin in safety

Authority NND 34869

switch assembly. For the Mk 258 Mod 0 Igniter, check for presence of 3-Pin Shorting Plug and Shorting Cap.) If any abnormal condition is apparent, reject the igniter. Inspect cap assembly threads for nicks or burrs which might prevent proper installation of igniter. Clean threads using a non-sparking copper wire brush.

WARNING

Do not install Mk 172 Mod 0 igniters in rocket motors to be used with F4H-1 aircraft. This igniter will malfunction in the ejection launcher installation.

NOTE: If a rocket motor or igniter is rejected for any reason, reject the unit in accordance with NAVORDINST 8025.1, Change 1, dated 12 February 1954, or other applicable directives.

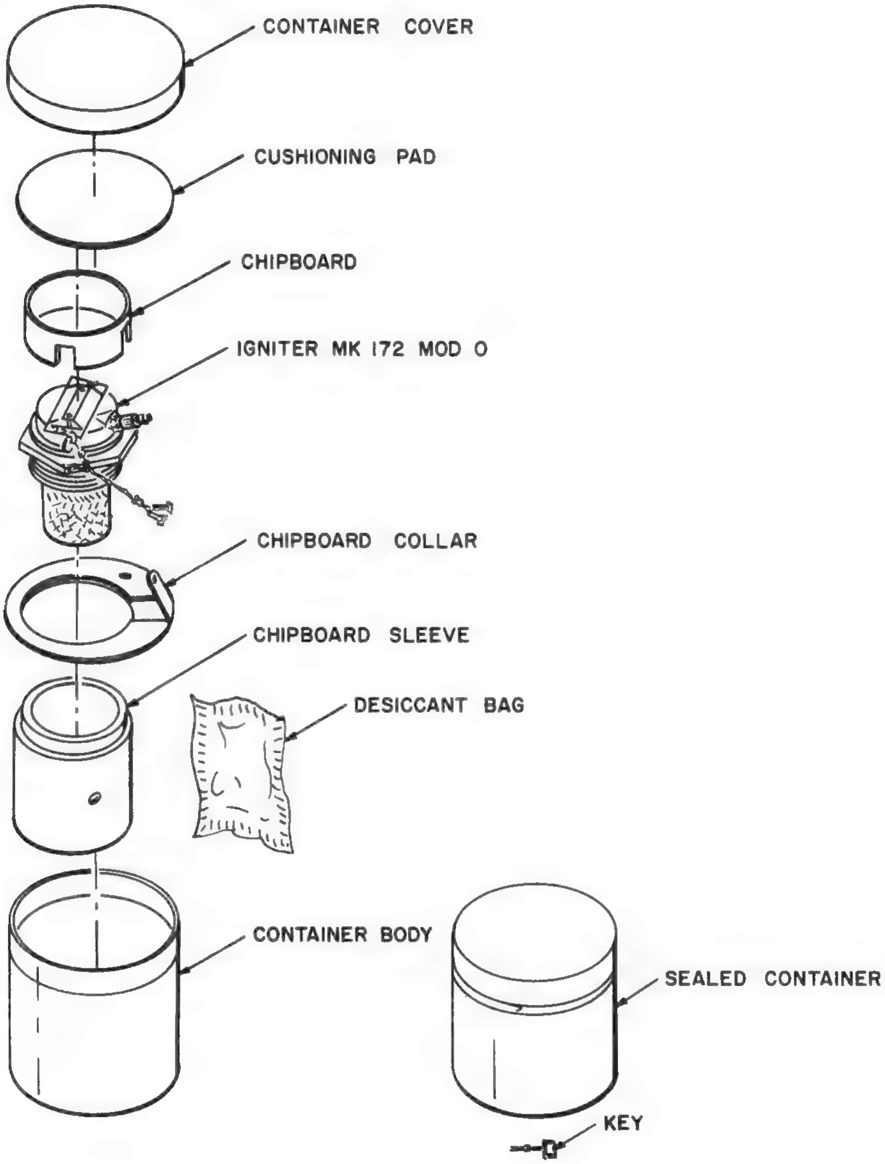


Figure 18—Igniter Mk 172 Mod 0 Container, Exploded View.

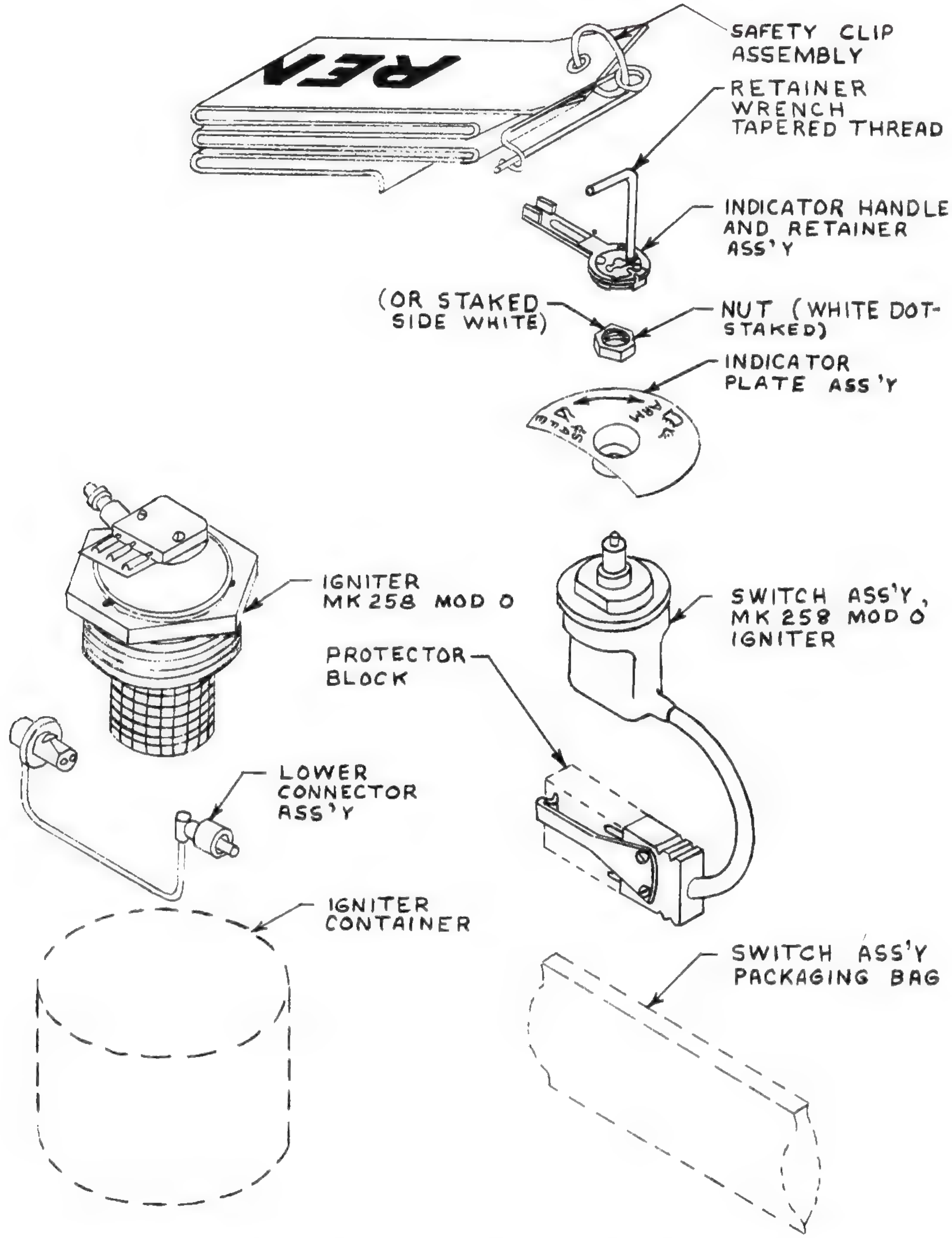


Figure 18A-Igniter Mk 258 Mod 0 Container Contents, Exploded View.

MK 172 MOD 0 Igniter Continuity Check. Firing requirements for the Mk 172 Mod 0 Igniter are listed in Table 5.

Perform an igniter continuity check as follows:

**WARNING**

> A continuity check of the igniter assembly must not exceed 30 seconds in duration. Wait at least five minutes before reapplying test current.

**WARNING**

> Igniter continuity checks are to be performed ONLY at Ordnance facilities where proper barricade and other safety equipment are available. UNDER NO circumstances will continuity checks be performed aboard ships or at air stations.

**Table 5—Firing Circuit Requirements**

| ITEM | VALUE |
|---|---|
| Recommended firing voltage | Standard Aircraft Power Supply. |
| Recommended minimum firing current to glow plugs. | 17 to 23 amperes |
| Maximum igniter tester current to glow plugs for continuity test purposes. | 0.04 ampere |
| Maximum safe no-fire current to glow plugs. | 2.5 amperes |
| Igniter resistance, two glow plugs in parallel. | 0.25 ohm |

1. Remove cotter pin, with instruction disk and lanyard assemblies attached, from igniter safety switch assembly, figure 6. Lay it aside.

2. Manually push slide plate to ARM position, figure 19.

3. Manually unscrew cap from receptacle, figure 6, and lay it aside.

4. Check igniter continuity with an ohmmeter as follows: Ground one ohmmeter lead to igniter cap assembly. Touch other ohmmeter lead to center terminal inside igniter receptacle. Depress ohmmeter button and read scale. Glow-plug resistance must be 0.25 ±0.05 ohm.

**WARNING**

> Any ohmmeter which passes more than 15 milliamps through the resistance being measured or is not accurate within ± two percent shall not be used. It may pass sufficient current to actuate the igniter.

5. Disconnect ohmmeter ground lead from igniter cap assembly.

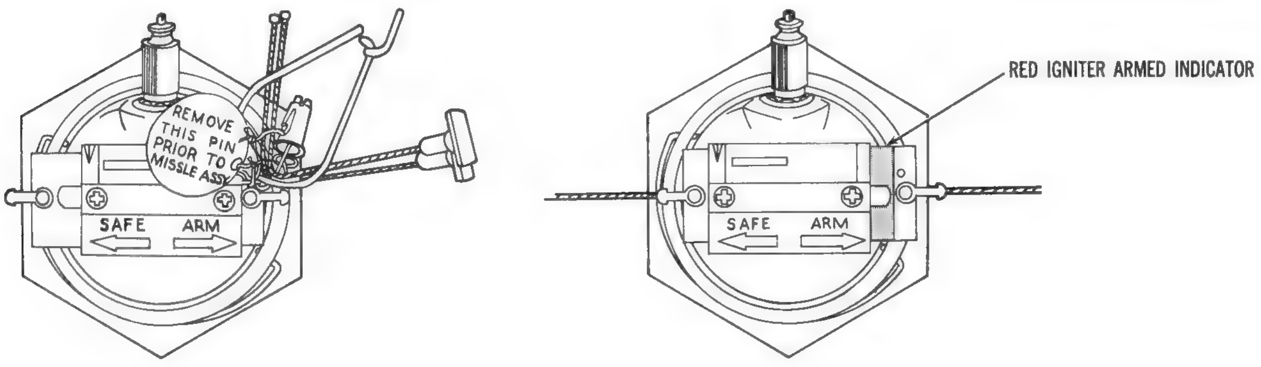
6. Replace cap on receptacle.

7. Manually push slide plate to SAFE position, figure 19, and replace cotter pin, with lanyards and instruction disk attached, in hole through slide plate and safety switch assembly.

8. Reject any igniter which does not pass continuity check. Reject the unit in accordance with NAVORDINST 8025.1, Change 1, dated 12 February 1954, or other applicable directives.

**WARNING**

> Do not install igniter in rocket motor until immediately prior to missile assembly.


REMOVE THIS PIN PRIOR TO MISSLE ASSY
SAFE
ARM
SAFE
ARM
RED IGNITER ARMED INDICATOR

SAFE POSITION

ARM POSITION

*Figure 19—Igniter Safety Switch Positions.*

MK 258 MOD 0 IGNITER CONTINUITY CHECK. Firing circuit requirements for the Mk 258 Mod 0 Igniter are listed in Table 5A. Perform an igniter continuity check as follows:

WARNING

> A continuity check of the igniter assembly must not exceed 30 seconds in duration. Wait at least five minutes before re-applying test current.

WARNING

> Igniter continuity checks are to be performed ONLY at ordnance facilities where proper barricade and other safety equipment are available. UNDER NO circumstances will continuity checks be performed aboard ships or at air stations.

1. Remove 3-Pin Shorting Plug from igniter and lay it aside.

2. Check igniter continuity as follows:

Ground one ohmmeter lead to shorting cap. Touch other ohmmeter lead to the center jack in the socket receptacle. Depress ohmmeter button and read scale. Igniter resistance must be 0.50±0.05 ohms.

WARNING

> Any ohmmeter which passes more than 5 milliamps through the resistance being measured or is not accurate within ±2% shall not be used. It may pass sufficient current to actuate the igniter.

3. Disconnect ohmmeter ground lead from igniter Shorting Cap.

TABLE 5A - FIRING CIRCUIT REQUIREMENTS

| Item | Value |
|---|---|
| Recommended firing voltage | Standard aircraft power supply |
| Recommended firing current to initiator. | 15 - 26 amperes. |
| Maximum igniter tester current to initiator for continuity test purposes. | 0.005 ampere. |
| Igniter resistance - two bridgewires in parallel. | 0.50±0.05 ohms |

4. Replace 3-Pin Shorting Plug in receptacle.

5. Reject any igniter which does not pass continuity check in accordance with NAVORDINST 8025.1, Change 1, dated 12 February 1954, or other applicable directives.

WARNING

> Do not install igniter in rocket motor until immediately prior to missile assembly.

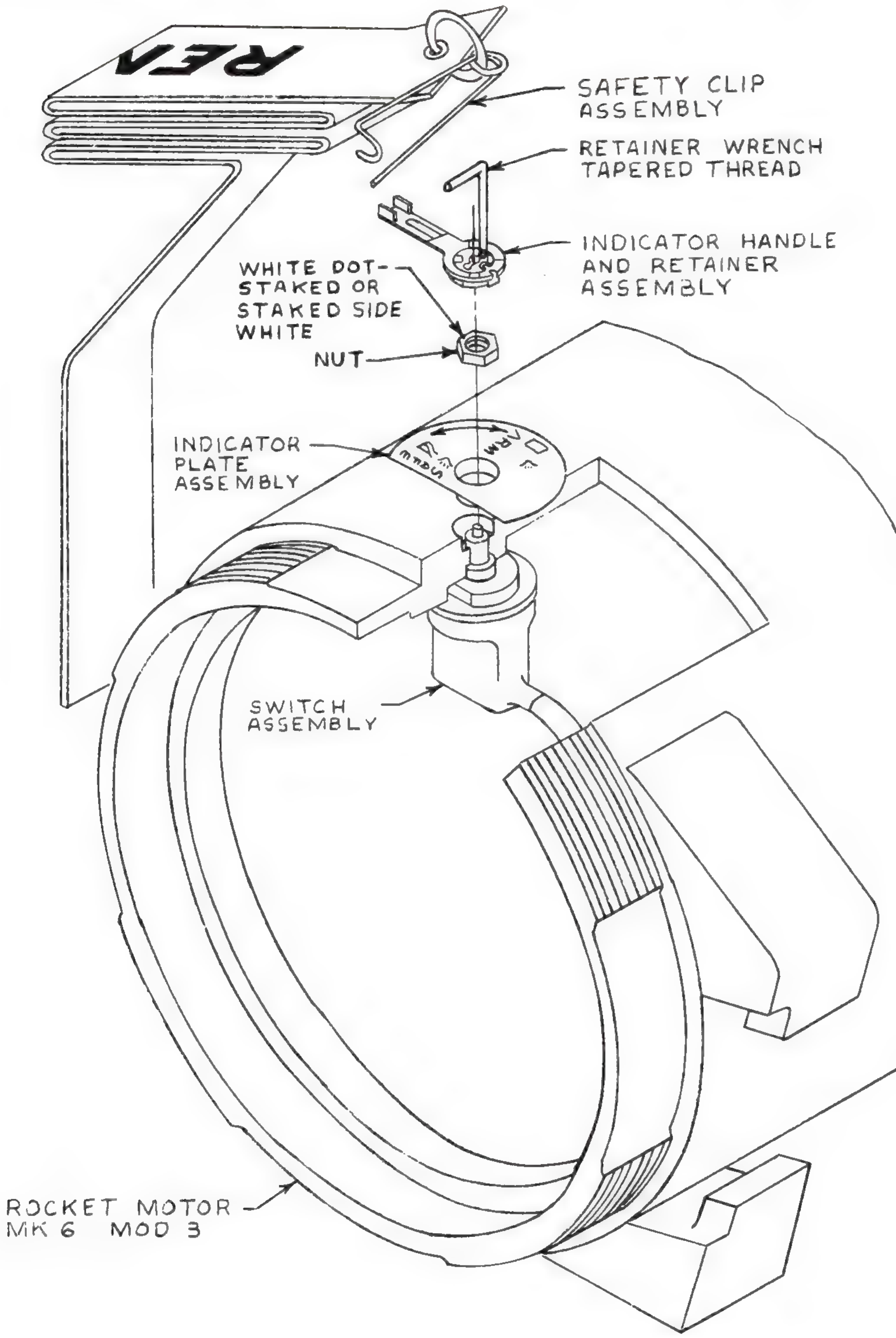

SAFETY CLIP ASSEMBLY
RETAINER WRENCH TAPERED THREAD
INDICATOR HANDLE AND RETAINER ASSEMBLY
WHITE DOT-STAKED OR STAKED SIDE WHITE
NUT
INDICATOR PLATE ASSEMBLY
SAFE
ARM
SWITCH ASSEMBLY
ROCKET MOTOR MK 6 MOD 3

Figure 19A-Mk 258 Mod 0 Igniter Switch Assembly, Exploded View.

**Nozzle Exit Cone.** Perform a pre-installation inspection of the nozzle exit cone as follows:

1. Remove nozzle exit cone from shipping package.
2. Visually inspect exit cone threads for nicks, burrs, foreign material, or evidence of rough handling. Reject the unit if threads are nicked or damaged. Clean foreign material from threads using a lint-free cloth and light oil, Military Specification MIL–C–15348A(1) or equivalent. Remove burrs using a nonsparking wire brush.
3. Make certain exit nozzle protection cap is intact and secure.
4. Replace nozzle exit cone in its shipping package until required for installation on motor.

## Installation Procedure

**Temperature Conditioning.** Satisfactory operation of the motor requires that storage temperature range be maintained within −75 to +150° F at all times. The motor must be conditioned to a temperature range between −10 and +140° F for at least 24 hours prior to operation.

**Rocket Motor.** Rocket Motor Mk 6 Mod 0 is secured to parent vehicle with a spring-loaded, button-type launch lug, figure 5. Rocket Motor Mk 6 Mod 1 is secured to missile by means of two launch hooks which are bolted to top section at forward end of chamber. Rocket Motor Mk 6 Mod 2 is identical to Rocket Motor Mk 6 Mod 1 in design and method of attachment except that Mk 6 Mod 2 contains heavier launch hooks and additional reinforcement in the forward attachment ring. Rocket Motor Mk 6 Mod 3 is identical to Rocket Motor Mk 6 Mod 2 with the following exception. Rocket Motor Mk 6 Mod 3 has three pairs of waveguide clips located 180 degrees from the top. These clip pairs are spaced 3.39, 16, and 32 inches from forward end of motor chamber, figure 3, and are used to mount a missile waveguide antenna.

**Exit Cone Assembly.** After the installation of the missile boattail, install nozzle exit cone on motor as follows:

1. Remove nozzle exit cone from package and clean threads using light oil, Military Specification MIL–C–15348A(1).
2. Coat nozzle exit cone threads lightly with thread lubricant, Military Specification MIL–T–5544A (ASG).
3. Remove weather seal cap, figure 8, from nozzle entrance assembly and lay it aside.
4. Clean nozzle entrance assembly threads with light oil, Military Specification MIL–C–15348A(1).
5. Carefully thread nozzle exit cone onto nozzle entrance assembly. Using a 6½ inch spanner wrench, tighten exit cone in nozzle entrance assembly.

> CAUTION: Do not force-thread nozzle exit cone. If parts do not thread easily, remove exit cone and clean threads on both nozzle exit cone and nozzle entrance assembly. Rethread nozzle exit cone onto nozzle entrance assembly.
>
> CAUTION: Make certain there is no separation between nozzle exit cone and nozzle entrance assembly.

6. Remove exit nozzle protection cap, figure 8, from nozzle exit cone.

**MK 172 Mod 0 Igniter Installation.** Install the igniter as follows:

**WARNING**

> The rocket motor is propulsive if accidentally actuated with igniter installed.

1. Remove igniter from its moisture-proof container. Make certain that slide plate, figure 6, is in SAFE position as shown in figure 18. Make certain cotter pin is installed through slide plate.
2. Remove shipping plug, figure 8, from igniter boss. Inspect boss threads for evidence of nicks, burrs, or foreign material. If threads are nicked, reject the motor. Clean burrs from threads using a nonsparking wire brush. Clean foreign material from threads using a clean, lint-free cloth and light oil, Military Specification MIL–C–15348A(1) or equivalent.
3. Lubricate igniter threads lightly with thread compound, Military Specification MIL–T–5544A (ASG).
4. Carefully thread igniter into igniter boss by hand until flange of igniter cap, figure 6, rests firmly against forward face of boss. Using a 2½-inch offset or socket hex wrench, tighten igniter in boss. Torque to 20 ±5 ft-lb

**WARNING**

> All igniter threads must be engaged and properly torqued to insure that igniter does not blow out on ignition and possibly detonate the missile warhead.

CAUTION: Do not apply torque to safety switch assembly, figure 6. The switch is made of aluminum and is free to rotate on igniter cap assembly.

5. Remove cotter pin, with instruction disk and lanyards attached, from safety switch assembly. Disconnect cotter pin from wire and replace pin in safety switch hole.

6. Assemble lanyard clip assemblies as shown in figure 6. Thread lanyards from outside through igniter wiring holes in forward attachment ring. Rotate igniter safety switch assembly so that word SAFE is readable on left, looking aft. Connect lanyard clips to igniter slide plate clips.

**WARNING**

When threading the switch lanyards, make certain the SAFE position on the switch housing is connected with position marked SAFE on outside of the rocket motor chamber.

CAUTION: Make certain arming clip loop is connected to ARM side of igniter slide plate, figure 6.

7. Remove cotter pin from safety switch slide.

8. Remove receptacle cap, figure 6, and attach external power connector to igniter receptacle.

**WARNING**

Just prior to aircraft take-off, manually arm igniter by pulling arming clip loop, figure 6, to ARM position. Remove arming clip loop from lanyard arming clip and install over SAFE lanyard button. This procedure will facilitate disarming igniter immediately after aircraft landing.

MK 258 MOD 0 IGNITER INSTALLATION. Install the igniter as follows:

WARNING

> The rocket motor is propulsive if accidentally actuated with igniter installed.

1. Remove the contents, Figure 18A from the plastic bag marked "S and A Switch Assembly BUWEPS LD 547598 for use with IGNITER MK 258 MOD 0 BUWEPS LD 547597".

The contents of the plastic bag shall consist of:

1 Switch Assembly (with 3-Pin Connector Plug Protector Block)
1 Indicator Plate Assembly
1 Safety Clip Assembly (with Flag)
1 Paper Envelope with Switch Indicator Accessories

The contents of the paper envelope containing the Switch Indicator Accessories shall consist of:

1 Switch Indicator Handle and Retainer Assembly
1 Nut
1 Retainer Wrench (Assembled with Retainer)

2. Insert the threaded (shaft) end of the Switch Assembly through the hole provided for same in the cylindrical side of the Rocket Motor, with the "body' of the switch and the "cable attached 3-pin connector plug" located inside the Rocket Motor forward attachment ring. (Facing the igniter end of the motor with the launching hooks at the 12 o'clock position, the proper hole is at 8 o'clock).

3. On the outside of the Rocket Motor, over the protruding threaded shaft end of the Switch Assembly, install the following accessories, as shown in Figure 19, in this order:

A. Indicator Plate Assembly. The "flat" in the hole of the Indicator Plate Cup will properly locate this Indicator Plate Assembly on the protruding threaded shaft end, which has a mating "flat" properly located.

B. Nut. Before this nut is snugged up tightly, the following procedure shall be followed.

> NOTE: This nut is identified by three stake marks punched in the upper surface and this same surface has either a white dot painted on it or is painted entirely white. The nut should be installed ONLY with the white dot-staked surface or the white surface UP and should be visible to the installer after finally snugged up into position.

Set the Switch Assembly Body so the "flat" on the Switch Body shall be parallel to surface "A" in view A-A, Figure 19B, on the internal offset ring machined inside the forward end of the Rocket Motor. Use a 0.005 to 0.055 feeler gauge for this setting. Now draw up the nut to a minimum 6 foot-pounds torque. However, if the Switch Body is still not secure, snug up the nut still further until the Switch Body is secure against rotational movement. Also make sure that the nut is tight enough to prevent rotation of the Indicator Plate Assembly.

WARNING

> If this nut must be removed after installation, it is imperative that it be replaced with a new nut to insure secure installation of the Switch Body.

> NOTE: Due to the small amount of clearance between the nut and the sides of the recessed hole of the Indicator Plate Assembly, it

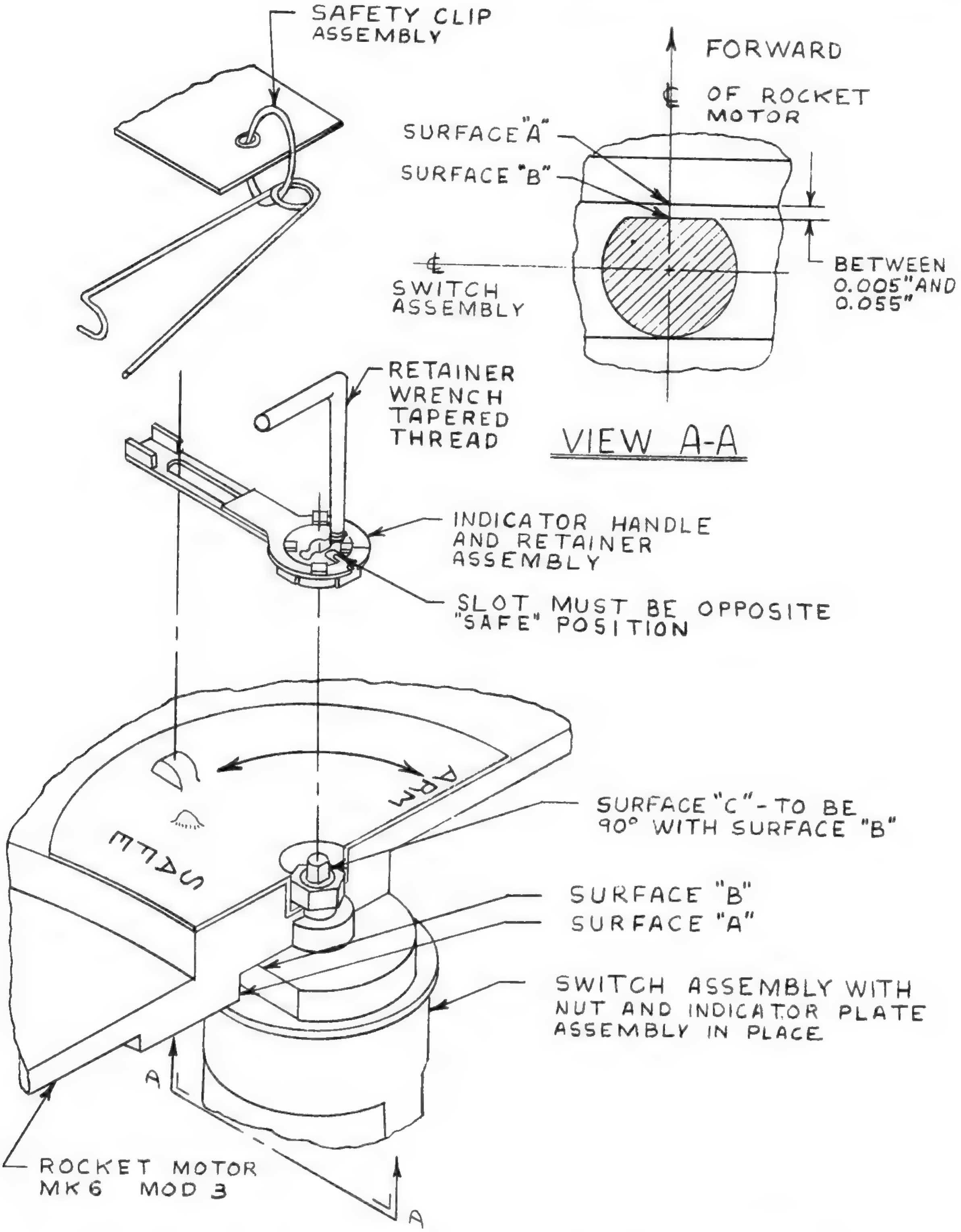

SAFETY CLIP ASSEMBLY
FORWARD
℄ OF ROCKET MOTOR
SURFACE "A"
SURFACE "B"
℄ SWITCH ASSEMBLY
BETWEEN 0.005" AND 0.055"
RETAINER WRENCH TAPERED THREAD
VIEW A-A
INDICATOR HANDLE AND RETAINER ASSEMBLY
SLOT MUST BE OPPOSITE "SAFE" POSITION
ARM
SAFE
SURFACE "C" - TO BE 90° WITH SURFACE "B"
SURFACE "B"
SURFACE "A"
SWITCH ASSEMBLY WITH NUT AND INDICATOR PLATE ASSEMBLY IN PLACE
A
A
ROCKET MOTOR MK 6 MOD 3

Figure 19B-Mk 258 Mod 0 Igniter Switch Assembly, Partially Assembled.

is recommended that a "thin-wall, deep-set, 12-point 11/32 socket be used" (Williams MD-1211 11/32, or equivalent).

C. Before installing the Indicator Handle and Retainer Assembly, be SURE that the "flat" on the switch shaft is in a position 90° from the "flat" on the body of the switch. This sets the switch in a SAFE position.

D. Install Indicator Handle and Retainer Assembly as follows:

> NOTE: The Indicator Handle and Retainer Assembly and Retainer Wrench are delivered in the paper envelope assembled at the proper setting, because, due to design and material it is imperative that the Retainer NOT be spread beyond its critical point of elasticity. Therefore, do NOT turn taper-threaded Retainer Wrench clockwise into Retainer beyond the assembled setting.

Place Switch Indicator Handle and Retainer Assembly (See Figure 19B) in the SAFE position over the Switch. Force the Indicator Handle and Retainer Assembly down as far as it will go. While firmly holding the assembly in position, remove Retainer Wrench by turning the wrench counterclockwise. The wrench may then be discarded.

WARNING

> A check shall be made to ascertain that the Handle is tightly in place.

The slot on the retainer must be opposite the SAFE position (See Figure 19B). In this position the Switch Indicator Handle will be up against the indicator stop and the raised loop in the Switch Indicator Plate Assembly will protrude through the slot in the Switch Indicator Handle.

E. Turn Switch Indicator to ARM position. The handle should be firmly locked in this ARM position due to the spring clip in the Indicator Plate Assembly locking over the handle. In this position, the handle will be up against the "stop bump" in the Indicator Plate Assembly.

4. Using an ohmmeter, the following tests will check the continuity of circuits originating and ending in the 3-pin connector plug in various combinations of SAFE and ARM positions of the Switch Indicator Handle.

WARNING

> It is mandatory that the switch installation and checkout be completed prior to igniter installation.

A. SAFE (large pin and center pin). The meter should read 0.0 ohms when testing the circuit from the large pin to the center pin, with the Switch in SAFE position.

B. SAFE (large pin and end pin). The meter should read "Infinite" ohms when testing the circuit from the large pin to the end pin, with the Switch in SAFE position.

C. ARM (two small pins). The meter should read 0.0 ohms when testing the circuit between the two small pins, with the Switch in ARM position.

D. ARM (large pin and center pin). The meter should read "Infinite" ohms when testing the circuit from the large pin to the center pin, with the Switch in ARM position.

5. Turn Switch Indicator Handle to

SAFE position (up against Indicator stop and with the loop in the handle slot). While Switch Indicator Handle is in this position, install the Safety Clip Assembly (this includes "REMOVE TO ARM" Safety Flag). In this position the LOCK portion of the SAFETY CLIP ASSEMBLY is inserted thru the loop and over the handle and the LOCK closed (See Figure 19C). This installation insures that the Switch Indicator Handle cannot be removed from the SAFE position until the Safety Clip Assembly has been removed.

6. Remove igniter from its moisture-proof container marked "one Igniter, Mk 258 Mod 0, BUWEPS LD 547597" etc, Figure 18A, being very careful not to remove or loosen the Shorting Cap which projects at an angle on the slanted side of the housing assembly of the igniter assembly or not to remove or loosen the 3-Pin Shorting Plug inserted in the socket receptacle of the housing assembly (Figure 6A). (The Lower Connector Assembly, Missile Motor Ignition, in the igniter container is for use in the F4H-1 aircraft only.)

The proper time for the removal of the Shorting Cap and the 3-Pin Shorting Plug will be given in the correct sequence later in these installation instructions.

7. Remove shipping plug, Figure 19D, from the igniter boss.

NOTE: Retain shipping plug. It is to be reinstalled should the removal of an igniter from a rocket motor become necessary.

Inspect boss threads for evidence of nicks, burrs, or foreign material. If threads are nicked, reject the motor. Clean burrs from threads using a non-sparking wire brush. Clean foreign material from threads using a clean, lint free cloth and light oil, Military Specification MIL-C-15348A(1) or equivalent.

8. Lubricate igniter threads lightly with thread compound, Military Specification MIL-T-5544A(ASG).

9. Carefully screw igniter into igniter boss by hand until flange of igniter cap, Figure 6b, rests firmly against forward face of boss. Using a 2-1/2-inch offset or socket hex wrench, tighten igniter in boss. Torque to 20±5 ft-lb.

WARNING

All igniter threads must be engaged and properly torqued to insure that igniter does not blow out on ignition and possibly detonate the missile warhead.

CAUTION: Do not apply torque to housing assembly, Figure 6A. The housing is made of aluminum and is free to rotate on igniter cap assembly.

10. Use the following procedure to install the 3-pin connector plug which is attached to the other end of the cable leading from the Switch Assembly Body.

A. Since the Housing Assembly, mounted on top of the Igniter Assembly, can be rotated 360°, position the Housing Assembly so that that side of the Socket Receptacle with the 3-Pin Shorting Plug inserted, points approximately in the direction of the previously installed Switch Assembly.

B. Only after executing 5 and 10A, should the 3-Pin Shorting Plug be removed from the Socket Receptacle located atop the Mk 258 Mod 0 Igniter Assembly which has been installed in the Rocket Motor as previously described.

C. Remove the protector block from the 3-pin connector plug.

D. Snap lock the 3-pin connector plug in place on the Socket Receptacle by means

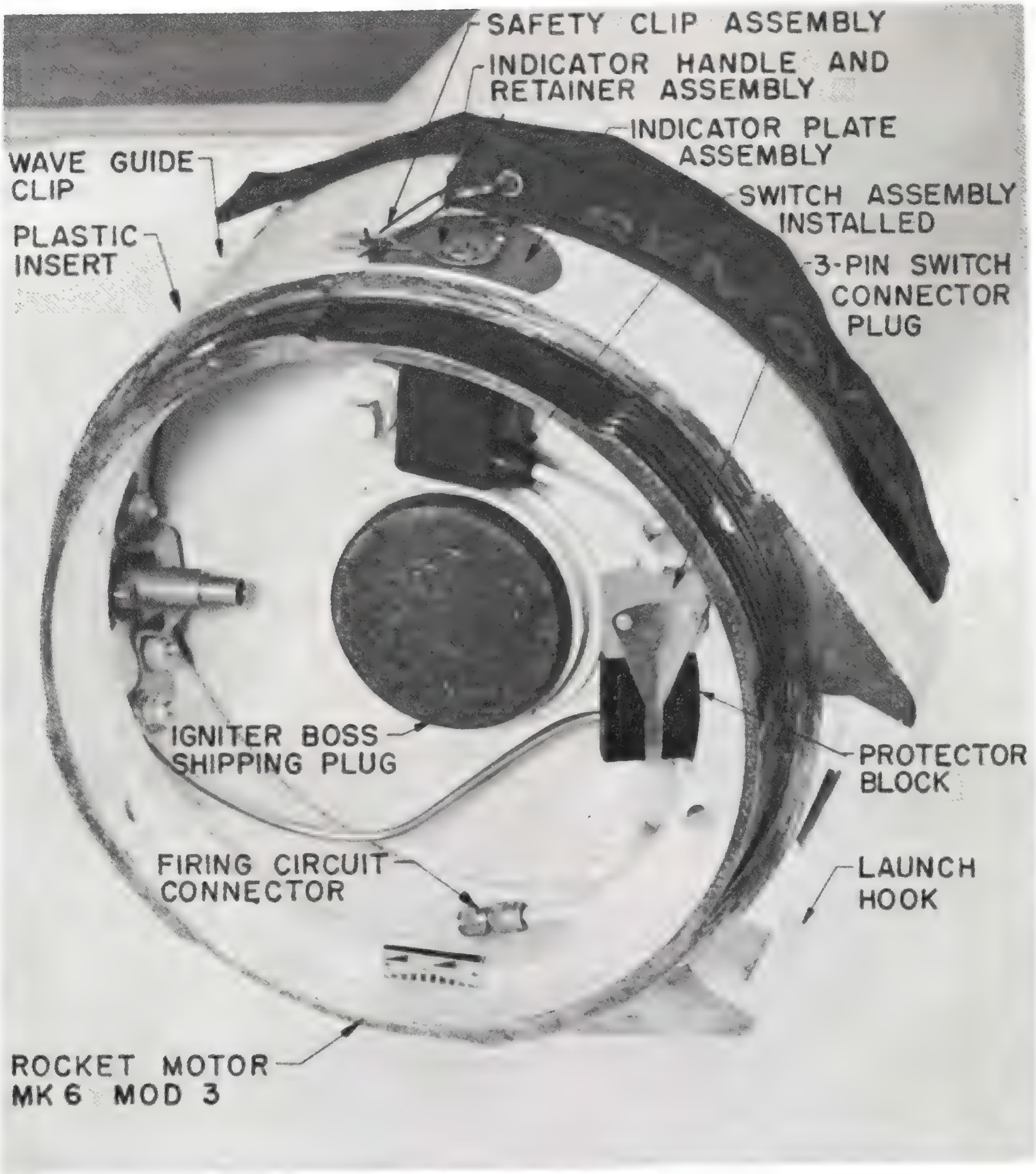


Figure 19C—Mk 258 Mod 0 Igniter Switch Assembly, Assembled.

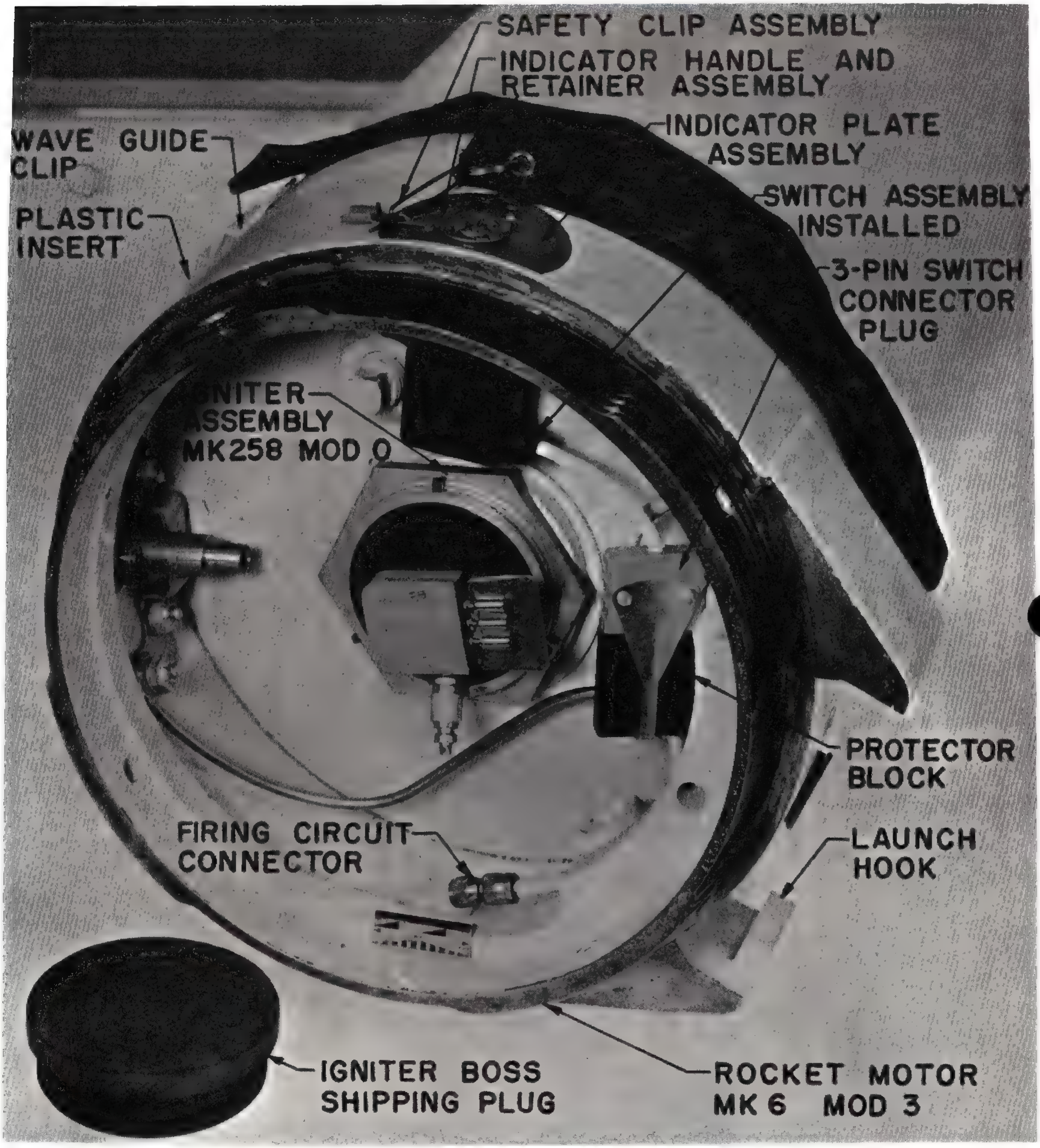


Figure 19D—Mk 258 Mod 0 Igniter and Igniter Switch Assembly Installed.

of the clip-spring on the 3-pin connector plug.

CAUTION

> Before proceeding with the installation of the Firing Circuit be very sure that the Switch Indicator Handle is in the SAFE position, and the Safety Clip Assembly is in place.

11. This is the ONLY time the Shorting Cap is to be removed from the Housing Assembly during the entire installation of the Complete Igniter Assembly Mk 258 Mod 0 and the Safety Switch into the Rocket Motor. Immediately after the removal of the Shorting Cap from the terminal on the Housing Assembly, install the Firing Circuit Connector on the same terminal. The complete igniter installation with the Indicator Handle locked in the SAFE position is shown in Figure 19E, and Figure 19F shows the Handle unlocked and in the ARM position.

WARNING

> Retain 3-Pin Shorting Plug and Shorting Cap. These are to be used should the removal of a loaded igniter from a rocket motor become necessary.

12. Obliterate the red colored "PULL TO ARM" and the green colored "PULL TO SAFE" decalcomanias on Rocket Motors, Mk 6 Mods, that are assembled with the Mk 258 Mod 0 igniters. The decalcomanias facilitate the installation of the Mk 172 Mod 0 igniter only and appear on some Mk 6 Rocket Motors.

WARNING

> Just prior to aircraft takeoff, manually arm igniter by removing the Safety Clip Assembly and turning the Switch Indicator Handle to ARM position. Retain Safety Clip Assembly to facilitate disarming igniter immediately after aircraft landing.

MK 258 MOD 0 IGNITER REMOVAL. Should the removal of the Mk 258 Mod 0 Igniter become necessary, the installation procedures for the igniter should be reversed. The retained 3-Pin Shorting Plug and the Shorting Cap should be reinstalled.

> NOTE: Replace igniter in shipping container until ready for reinstallation in motor. Make certain desiccant placed in container is fresh. Wrap tape aroung lid-to-can joint to exclude moist air.

The Firing Circuit Connector should be taped to the inside of the forward attachment ring of the Rocket Motor.

> NOTE: Should the Indicator Handle, Indicator Plate, or both, become damaged, they should be removed by reversing the installation procedure and inspected. Also, make sure that the switch has not been damaged. New components should be installed using the aforementioned installation procedures. After installing the new components, the circuit continuity checks of paragraph 4 should be conducted.

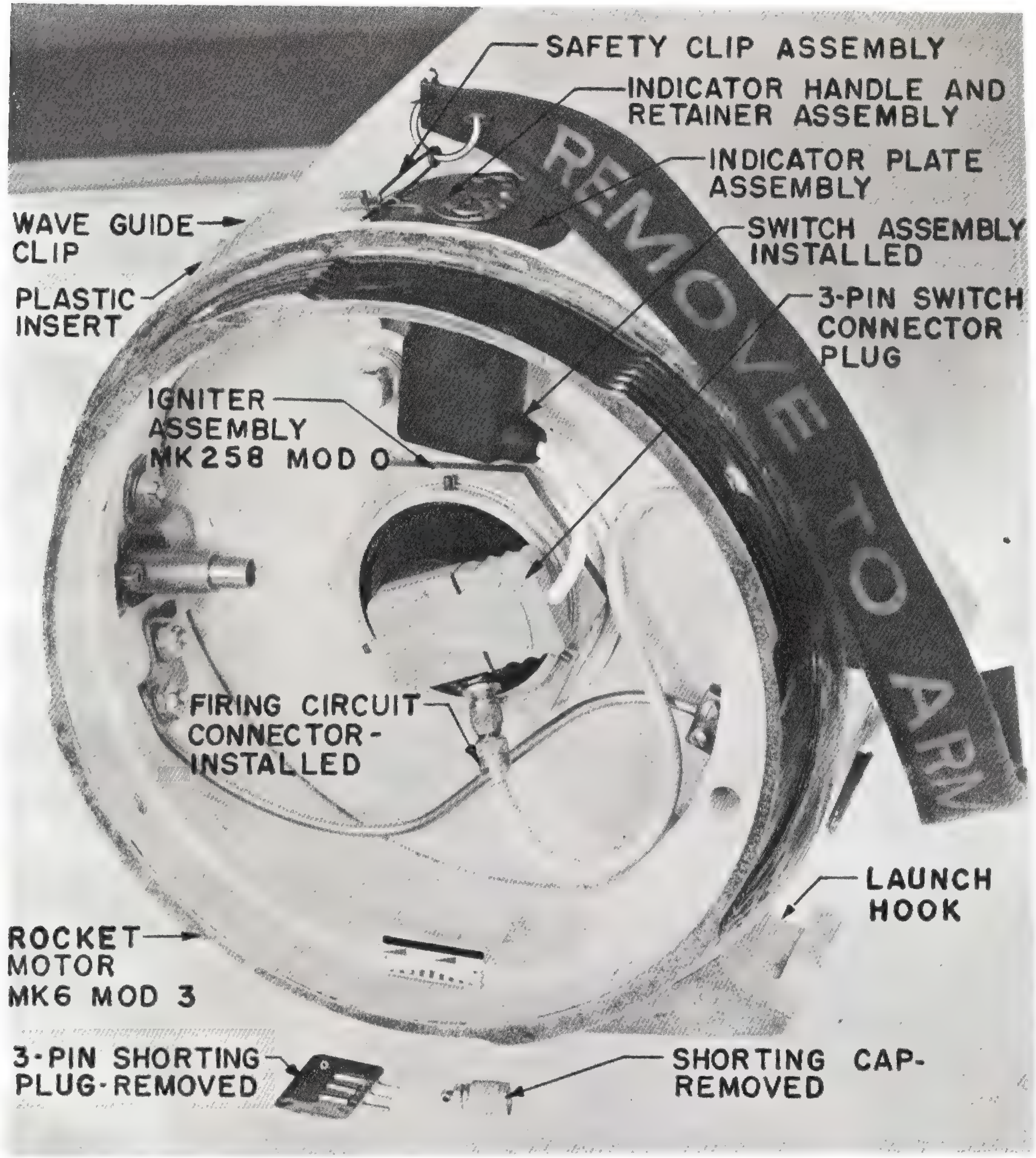

SAFETY CLIP ASSEMBLY
INDICATOR HANDLE AND RETAINER ASSEMBLY
INDICATOR PLATE ASSEMBLY
SWITCH ASSEMBLY INSTALLED
3-PIN SWITCH CONNECTOR PLUG
WAVE GUIDE CLIP
PLASTIC INSERT
IGNITER ASSEMBLY MK258 MOD 0
REMOVE TO ARM
FIRING CIRCUIT CONNECTOR-INSTALLED
LAUNCH HOOK
ROCKET MOTOR MK6 MOD 3
3-PIN SHORTING PLUG-REMOVED
SHORTING CAP-REMOVED

Figure 19E—Mk 258 Mod 0 Igniter and Igniter Switch Assembly Installed and the 3-Pin Shorting Plug and Shorting Cap Removed.

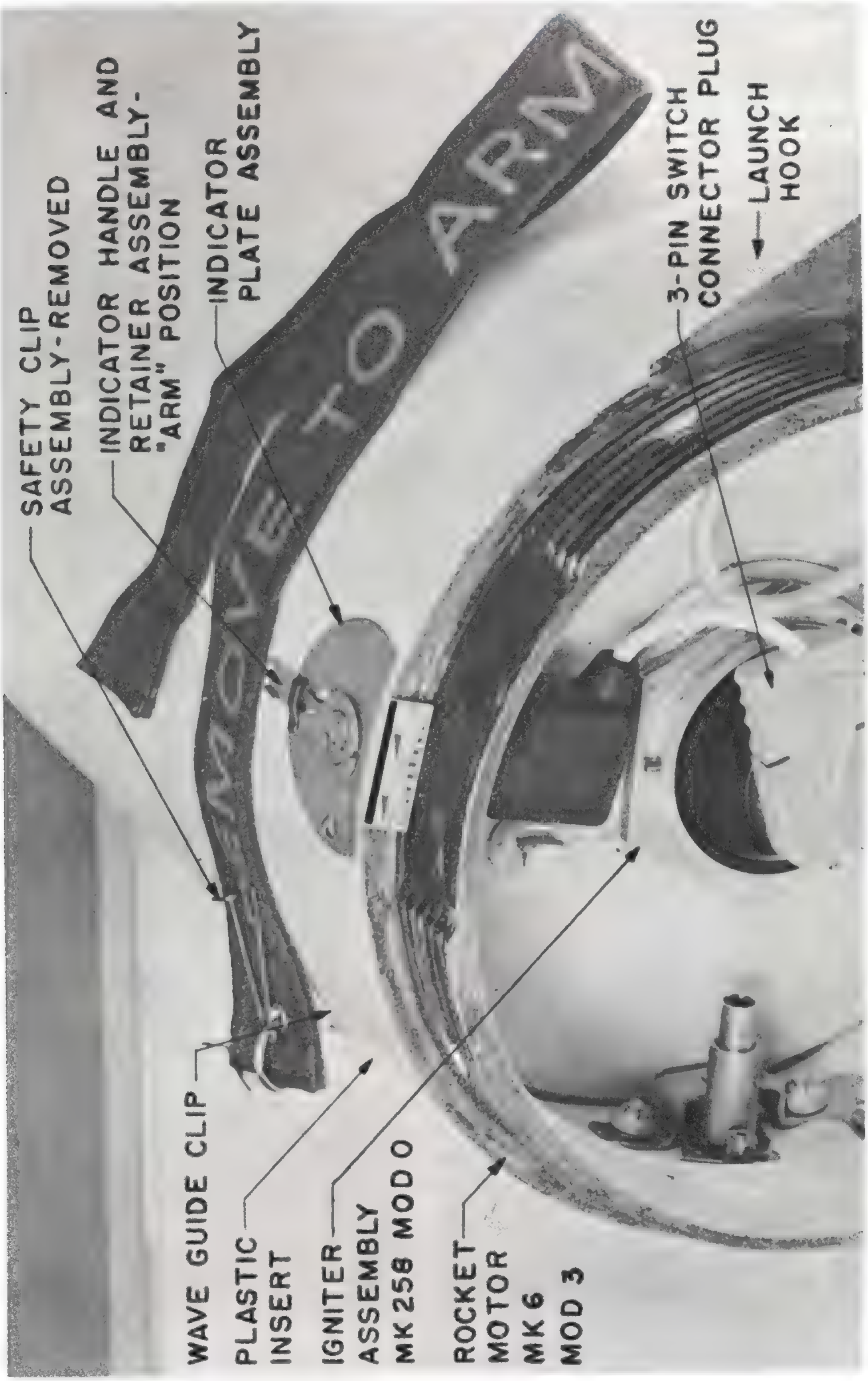

SAFETY CLIP ASSEMBLY-REMOVED
INDICATOR HANDLE AND RETAINER ASSEMBLY- "ARM" POSITION
INDICATOR PLATE ASSEMBLY
3-PIN SWITCH CONNECTOR PLUG
LAUNCH HOOK
MOVE TO ARM
WAVE GUIDE CLIP
PLASTIC INSERT
IGNITER ASSEMBLY MK 258 MOD 0
ROCKET MOTOR MK 6 MOD 3

Figure 19F—Mk 258 Mod 0 Igniter and Igniter Switch Assembly Installed, "ARM" Position.

# CHAPTER 7

# OPERATIONAL LIMITS

## FLIGHT LIMITS

As specified by the Bureau of Naval Weapons, operational limits for airborne applications of Rocket Motor Mk 6 and Mods are as follows:

1. No limitation on rate of climb or descent.
2. No limitation on air temperature and time limits, providing motor is maintained at a storage temperature range between -75 to +150°F and providing propellant has been preconditioned to a temperature between -10 and +140°F for a minimum of 24 hours prior to use.
3. No limitations on number of catapult takeoffs and arrested landings on carrier-based aircraft.

## EFFECT OF TEMPERATURE ON IGNITION INTERVAL

A long ignition interval, fire switch to 90 percent of rated thrust, can be expected with Igniter Mk 172 Mod 0 or Mk 258 Mod 0 fired at low temperatures. Igniters fired at higher temperatures have a shorter ignition interval. The effect of temperature on ignition interval of the Mk 172 Mod 0 Igniter is shown in figure 10.

## EFFECT OF TEMPERATURE ON ROCKET MOTOR PERFORMANCE

Thrust of Rocket Motor Mk 6 Mod 3 and duration of thrust are dependent upon the temperature of the propellant grain at time of firing, figure 20. As propellant temperature rises, thrust increases and duration becomes shorter. As firing temperature lowers, thrust decreases and duration becomes longer. The total impulse remains fairly constant.

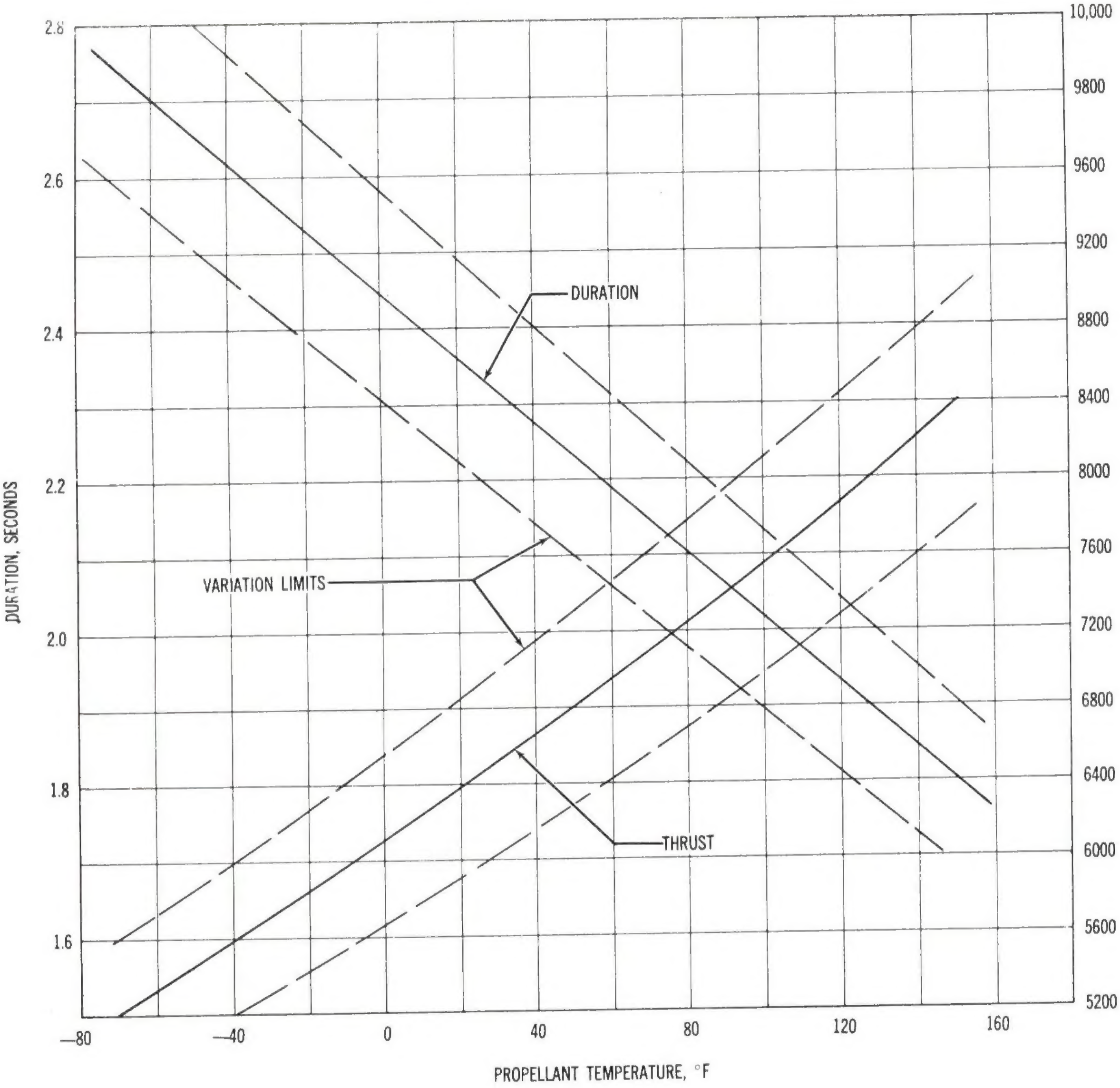


*Figure 20—Effect of Temperature on Rocket Motor Performance.*

## Chapter 8

# MISFIRES, HANGFIRES, MAINTENANCE, AND LUBRICATION

## Misfires and Hangfires

**Definitions.** A misfire occurs when a rocket motor fails to fire either from an electrical circuit failure, igniter failure, or complete failure of propellant to ignite for any reason after firing circuits are closed.

A hangfire occurs in a motor when the igniter fires but ignition of the propellant is delayed for time periods up to 10 minutes after close of firing switch. During this hangfire time period, the propellant may partially ignite and smoulder or chuff before developing sufficient thrust to leave the launcher.

**In-Flight Hangfire Procedure.** A hangfire will be considered to exist when the motor firing switch is closed and missile fails to launch. In the event of an in-flight hangfire, proceed as follows:

1. Immediately place all cockpit firing switches in motor electrical circuit in SAFE, electric current OFF position.

**WARNING**

> The motor should be considered a hangfire for a period of 10 minutes after motor fire switch has been placed in OFF position.

2. During 10-minute hangfire period, fly aircraft on a course or courses which will minimize missile hazard in the event launching occurs. The missile must be jettisoned should the aircraft be unable to remain airborne in a safe area for the 10-minute hangfire period.

**WARNING**

> If aircraft is forced to return to its base with a hangfire rocket motor, every effort must be made to keep aircraft oriented, during and after landing, in a direction that would minimize hazard in the event the rocket motor fires.

> NOTE: Upon completion of 10-minute hangfire period, the motor is considered SAFE and is declared a MISFIRE. The aircraft may resume normal operations or return to its base.

**Carrier or Shore-Base Misfire Procedure.** In the event of a carrier or shore-base misfire, proceed as follows:

1. Upon landing, pull the Mk 172 Mod 0 safety switch lanyard, figure 6, on mis-fired motor to SAFE.
2. Disconnect firing circuit external to missile if possible.
3. Disassemble motor from missile and remove igniter. If igniter did not fire, perform an electrical check on motor electrical firing circuits in aircraft and missile to determine that correct voltage was applied to igniter.

**WARNING**

> Under no circumstances are electrical continuity or other electrical checks to be made on igniters that have been removed from misfired motors. Dispose of igniter in accordance with paragraph titled Rejection Procedure.

4. If igniter fired, dispose of motor in accordance with paragraph titled Rejection Procedure.
5. Forward information listed in table 6, concerning misfires or hangfires attributed to motors or igniters, to the Bureau of Naval Weapons.

**Table 6—Information Concerning Misfires or Hangfires**

| ITEM |
|---|
| 1. Serial number of rocket motor. |
| 2. Lot and batch number of igniter. |
| 3. Model and bureau number of launching aircraft. |
| 4. Altitude of launching aircraft at time of attempted launch. |
| 5. Outside air temperature at altitude of attempted launch and time at altitude. |
| 6. Shipboard storage and handling history of rocket motor and igniter. |
| 7. Any other information considered pertinent. |

## Maintenance

Rocket Motor Mk 6 Mod 3 is not subject to maintenance in the field.

## Lubrication

Other than the lubrication described earlier in this publication, no special lubrication of Rocket Motor Mk 6 Mod 3 is necessary in the field. Table 7 is a summary of lubrication requirements listing parts and lubrication or corrosion preventive required.

**Table 7—Summary of Lubrication Requirements**

| PART | MILITARY SPECIFICATION | NOMENCLATURE |
|---|---|---|
| Launch hooks | MIL-L-21260 | Lubricating Oil, Internal-Combustion Engine, Preservative. |
| Forward attachment ring threads and all unpainted surfaces. | MIL-C-16173 Grades I and III. | Corrosion Preventive Compound Solvent Cutback, Cold-Application. |
| Nozzle exit cone, nozzle entrance and igniter boss threads. | MIL-T-5544A (ASG). | Thread Compound, Anti-Seize, Graphite Petrolatum. |